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STINGLESS BEE NEST FOR HOUSING AREA IN MALAYSIA

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ABSTRACT

Meliponiculture is an activity of stingless beekeeping, where the colony of stingless bees extracted from the wild for the purpose of profit. It is the art and science of keeping stingless bees for honey, pollen, resin and ecological services. With the managing of bees in artificial hives, it enables beekeeper to propagate colonies and produce products such as honey, pollen and propolis.

This study aims to propose a suitable design for stingless bee nest, which will be using in a small housing area in Malaysia. Colonies of G. Thoracica were used to study the nest structure and growth, foraging activity and morphometry of worker bee. With this study, it is hoped that many more users can involve in meliponiculture for domestic purposes, which will also contribute to the Malaysian economy in general.

INTRODUCTION

Geniotrigona thoracica, is one of the largest stingless bee in Malaysia and has economy potential used in meliponiculture. They are able to produce honey similar to honey bees. The stingless bees colonies managed in artificial hives enables bee keepers to propagate colonies and also to produce products such as honey, pollen, cerumen and propolis. The meliponiculture industry is new in Malaysia, whereas this activity widely practiced in Brazil, Mexico, Africa, Australia and Thailand.

Meliponiculture allow bee farmers to generate income by selling stingless bee colonies, honey, bee bread propolis, pollination services, educational services and agro tourism. Most of the stingless bee company are from local because it gives the potential for them to increase their economy and the surrounding area are very suitable to have an active stingless bee that can produce a lot of honey and pollen.

In order to sustain the meliponiculture industry in Malaysia, research on design criteria of the nest features and behaviour of stingless bees were needed. Thus, the aim of this study is to propose design criteria of stingless bee nest for small housing area in order to solve the discover problems and as an alternative where the product can provide an opportunity to the community to get involved in meliponiculture industry in Malaysia.

CONCEPTUAL PROCESS, PROCEDURE AND SCHEMATIC

This stingless bee nest called ZEN HACHI; it is the new trend for stingless bee nest product in Malaysia (Figure1). The name of the product itself represents the safety of the structure in Japanese which means (safety bee). The design produced a modern and simple concept inspired by the basic structure of Japanese lunch box (Bento).

The hexagon shape of the storage represents the beehive itself while full structure indicate the shape of a modern flower pot which is very suitable to be placed at housing area. Instead of giving weight at the top shield for safety, it also can be replaced and flower pot itself as the farmer can put any suitable plant on top of it. The flower pot will give a source of food to the bee for honey and pollen making. Therefore, the beekeeper can have less concern about the surrounding plant. The storage will not easily open by the human or other animals to make the bee worker feels safe during the foraging process.

RESEARCH METHODOLOGY

Figure 1: Zen Hachi bee nest

A case study was conducted in the area chosen which is Madu Kelulut Pak Ya, and housing area at Kg, Soi, Kuantan, Pahang, Malaysia. This area has been chosen as the case study and survey area as it is one of the meliponiculture industry in Malaysia. To gain a better understanding of the relationship between the existing product of stingless bee nest, the behaviour of 30 kinds of stingless bee species, and also the suitable environment and pollen favour needed by stingless bee species. The study is site inventory, semi-structured interview and survey questionnaire. The semi-conducted interviews were conducted with six local farmers and company owners who have expertise in structures based on the phenomenon and behaviour of stingless bee.

FINDINGS AND DISCUSSIONS

STINGLESS BEE NEST LINE UP ANALYSIS

A total of 30 samples of stingless bee nest from 2 places in Kuantan Pahang were analyzed. The result indicates that there are two (2) kinds of nest structure; with proper length and shield and without proper long and shield. Main features of bee nest were analyzed in terms of its stand, log, shield, area, safety and honey extraction condition. Most of the nest have all the main features but it is in improper condition, which may lead to the decreasing in the honey production. It is observed that features of the nest affect the safety of the bees as well as the people near the nest. The people will feel insecure while open the top shield of the nest to get the honey because they can easily see the active bees in the nest. Although the stingless bees usually do not sting, whenever it is in the insecure condition, it may bite people and other animals. At this condition, bee keepers need to wear a safety attire to prevent from bees attack. Based on the observation that has been done, it is a need to have a proper stingless bee artificial nest with safety features.

TYPES OF PLANTS FOR HONEY MAKING

The genera of stingless bees play an important role as pollinators of plants. These bees are actively involved in the pollination of agricultural crops and known to have preferences in selecting flowers to pollinate. Although many flowering plants are capable to self-pollinate, cross-pollination is needed to increase the genetic diversity of plants. In cross-pollination, pollens are transferred by wind, water, birds, bats, or bees. Bees are after one thing and that's the food in flowers: pollen and nectar. So the more flowers in the garden, the more bees will attract. Some flowers are more attractive to the bees because they may have more pollen and nectar. Some of the flowers may bloom at a particular time which other flowers are not blooming yet. Different structures of flower may also lead to the attraction of the bees, which wider petal may give bees more areas to collect pollen and nectar from the flower. There are several top plants are such as Abelia, Callistemon, Daisies, Tea Tree, Cupanopsis, River Lily, Apple and many more.

Figure 2: Several Types Of Plants For Honey Making

TYPES OF STINGLESS BEE

Stingless bee is an insect that lives in a perennial colony together with the queen, workers (sterile female) and drone (male bee) which fly and collecting the pollens and inorganic salt from various sources. There's a lot of species of stingless bees from 14 genera have been identified, and only some species such as Geniotrigona thoracica, Heterotrigona itama, Lepidotrigona terminata, Tetragonula fuscobalteata and Tetragonula leaviceps that being commercialized in meliponiculture industry for honey production in Malaysia. As highlighted by Wan Nur Asiah (2015), "the flight activity particularly of two species namely, Heterotrigona itama and Geniotrigona thoracica were significant affected by temperature, relative humidity, moderate light intensity and hours of treatments ." Hence, some of these species such as Heterotrigona itama and Geniotrigona thoracica (Figures 2.a- 2.b) is the largest and suitable species that could produce honey in Malaysia.

Figure 2.a: Stingless bee species Heterotrigona itama

Figure 2.b: Stingless bee species Geniotrigona thoracica

STINGLESS BEE NEST STRUCTURE

Figure 2.3. External and internal nest structure of G. Thoracica. (a)- The front view of external nest (entrance) (b)- side view of external nest (entrance) showed (c)- the view of internal nest

TYPES OF COLORS FOR HONEY OF STINGLESS BEE

Each colony produce a different type of colour and taste of honey for each nest, which depends on the types of flowers' pollen as its food source. The honey taste, which is more towards sweet and fruity taste are depending on the source of the pollen from the flowers. The darker the colour of the honey will make the taste of honey become sour. Oppositely, the lighter the colour of honey indicates the sweeter taste. (Refer to Figure 3).

Figure 3: Types Of Plants For Honey Production
Source: http://healthyhabitshub.com/how-to-choose-the-best-honey/

Table 1: Different type of colour and taste from stingless bee honey

Figure	A	B	C	D	E
Colour	Dark Amber	Amber	Dark yellow	Yellow	White Colourless
Taste	Bitter	Sour	Sweet sour	Sweet	Sweetness
Flower Sample	Sourwood tree	Lily tree	Blueberry	Aster	Acacia Alfalfa

LAYOUT PLAN OF NEST ARRANGEMENT

Two types of stingless bee nest arrangement ha been analyzed in two different places as shown in figure 4.a- 4.b. Plan (a) is the landscape of stingless bee nest arrangement at En. Abdul Aziz's housing area while Plan (b) is the landscape of nest arrangement at En. Haziman's housing area. Both areas have a different type of nest arrangement. Plan A shows that the arrangement of the nest is quite far from others but some of the nest were facing each other entrance. The area also doesn't have enough plants as a food source. While Plan B shows the arrangement of the nest is close to each other, yet the position of the entrance was facing opposite from others where it much safer for colonies in each different nest.

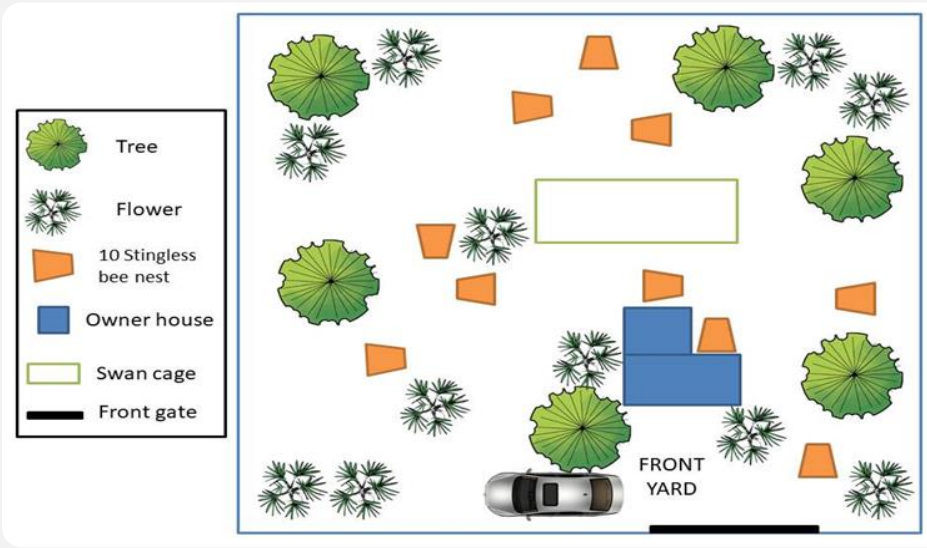

Figure 4.a: Layout plan of nest arrangement at En. Aziz's house yard

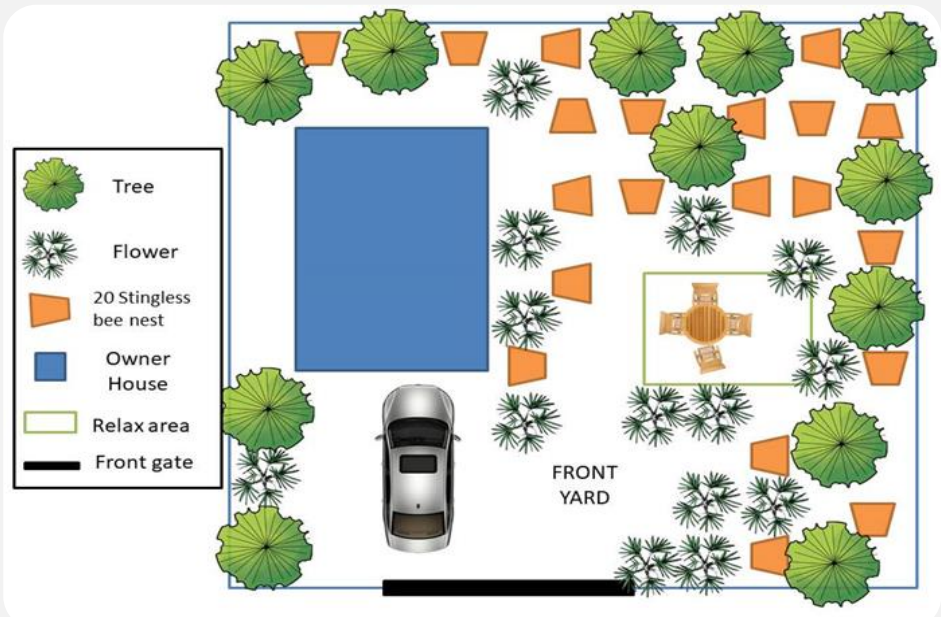

Figure 4.b: Layout Plan of nest arrangement at En. Haziman's house yard

Line up analysis

The table shows that all 30 of the nest has their basic structure: log, storage and top shield but most of the nests have improper physical features and surrounding which make the condition of honey extraction is low. Plus, the study shows the features of the nest also affect the safety among stingless bee colonies and people around the nest. People will be insecure while opened the top shield of the nest if the colony is an active species such as G. Thoracica . Although, stingless bees are not sting but they can bite whenever they feel insecure around their nest. By this result, it shows that there is a need for future studies on a proper nest in design, cost, and safety. So that the foraging process will be smooth, and the farmer will get high benefit on keeping the stingless bee colonies.

Table 2. Physical features of the Stingless bee nest and Honey extraction condition

Nest	Main Features					Safety		Honey Extraction Condition		
	Stand	Proper log	Storage	Proper shield	Suitable area	Colony	Human	Per week	Per month	None
1	√	√	√	√	√	√	√	√		
2	√	√	√	√		√		√		
3	√		√		√		√			√
4		√	√	√	√		√		√	
5	√		√	√			√			√
6	√	√	√		√			√		
7	√	√	√	√		√	√		√	
8	√	√	√		√		√		√	
9			√							√
10	√		√		√					√
11	√	√	√			√	√		√	
12	√	√	√			√	√	√		
13		√	√	√	√		√		√	
14	√	√	√	√		√	√		√	
15	√		√	√	√		√			√
16	√		√		√					√
17	√	√	√	√		√	√		√	
18	√	√	√	√	√	√	√	√		
19	√	√	√		√			√		
20	√	√	√		√	√	√		√	
21	√		√		√					√
22		√	√	√	√		√		√	
23	√	√	√		√			√		
24	√	√	√	√		√	√		√	
25	√	√	√	√		√	√	√		
26	√		√							√
27			√		√					√
28	√	√	√		√		√	√		
29	√	√	√	√		√	√		√	
30	√		√	√			√			√
Score	25/30	20/30	30/30	15/30	17/30	12/30	20/30	9/30	11/30	10/30

DESIGN DEVELOPMENT & FINAL DESIGN PROPOSAL

IDEA SKETCHES

The idea exploration started with sketches of a few thumbnails to brainstorm a various idea. It was started with the basic shape of each component in the product. This process assisted the possibilities of idea it might be. Thumbnail did and a few of them are selected for further exploration in the design proposal stage. There are four idea proposals have been made to study the composition as well as the form of each component in the product. The sketches give a general view as it was drawn part by part of the form and composition. Then, the process continues with the final design development for the selected idea.

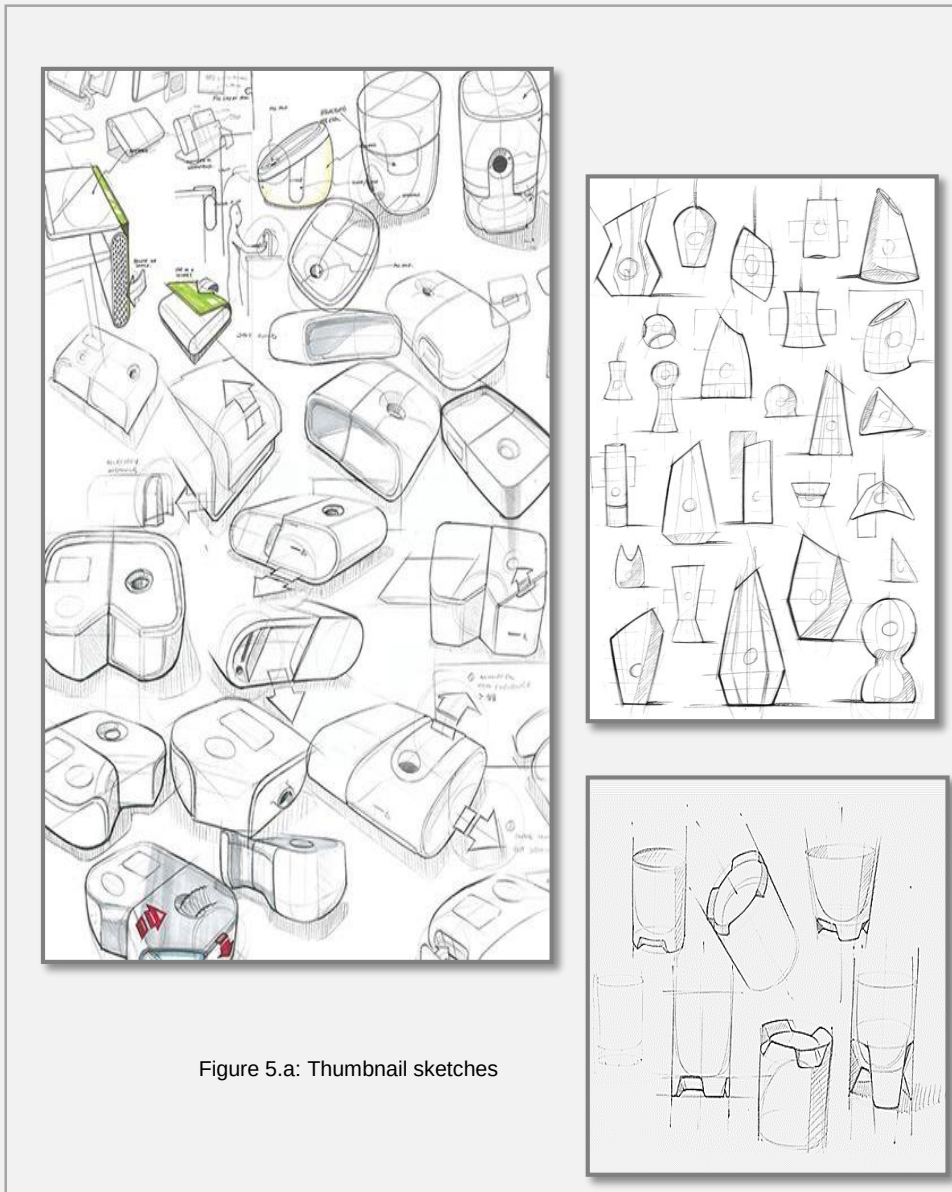

Figure 5.a: Thumbnail sketches

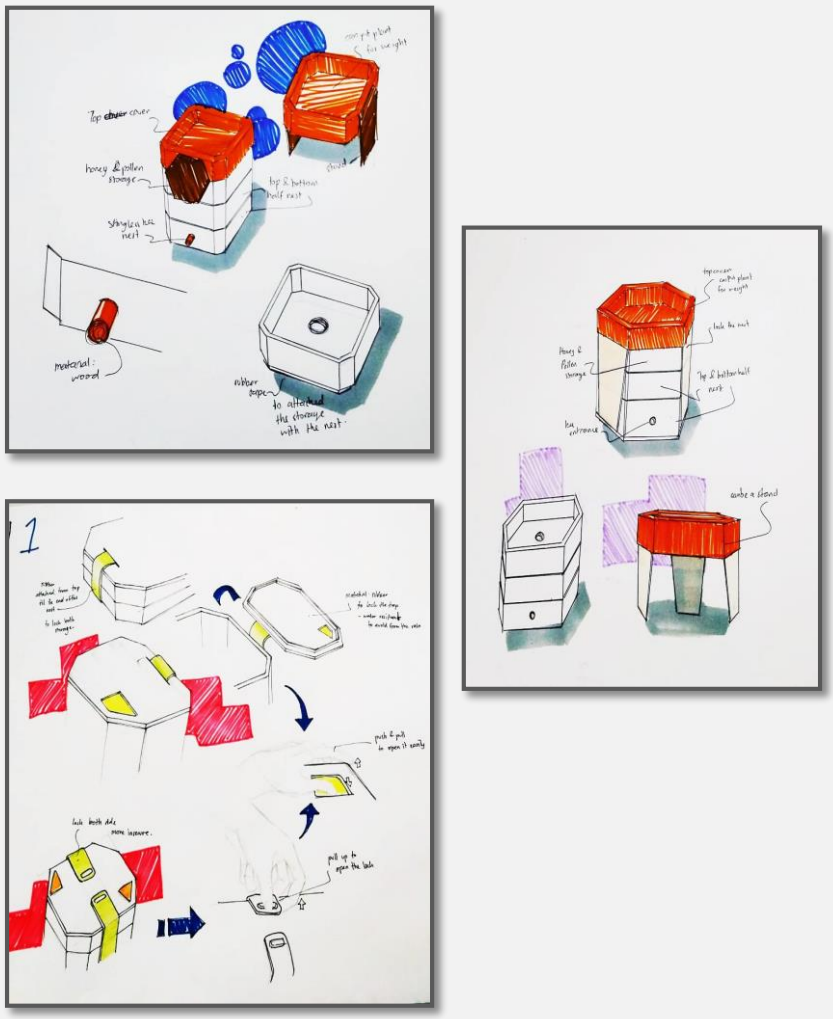

Figure 5.b: Ideation Sketch 2

Mock-Up

The next step was projecting the ideas on sketches into a structural form, to study the basic solid form of realization. It is important to transfer the sketched ideas into the mock-up form, as to make sure the ideas are proved to be realistic or not. The mock-up has been done made into actual size, which is easier to achieve the ergonomic studies of the product. This mock-up gives a clear understanding of how to make it and possible problem that probably faces in the model making process.

Figure 6.a: First Mock up development (a) perspective view (b) inside the storage

Figure 6.b: Second Mock up development (a) perspective view (b) top and the hive

Figure 6.c: Third Mock up development (a) perspective view (b) top and the hive

TECHNICAL DRAWING

The technical drawing of the product could be easily obtained through the 3D model build-up, by projecting the wireframe through related perspective views. By technical drawing, the process of model making would be easy and the realistic size could be estimated.

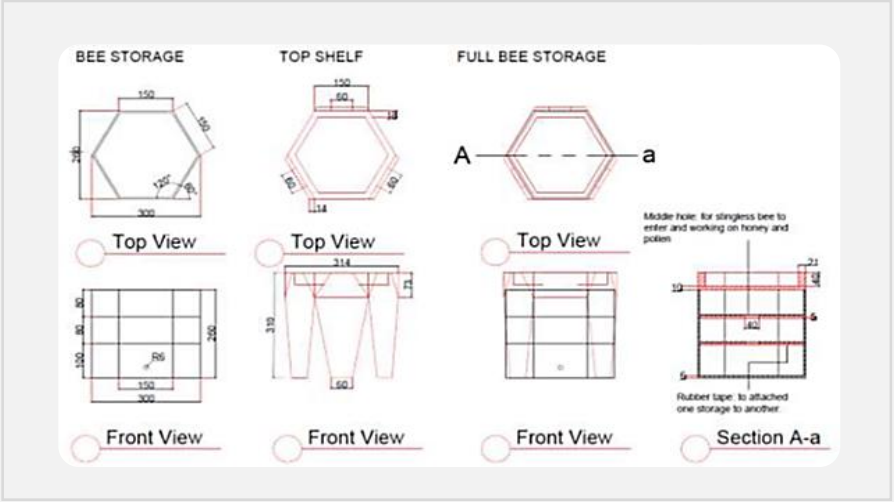

Figure 7: Technical Drawing of Zen Hachi

MODEL MAKING PROCESS

To test the practicality of stingless bee nest, a prototype model was built as the first sample to be learned. Materials used for model prototyping process that is being used and practiced in the real industry for making stingless bee nest is Maple and Nyatoh wood. This kind of wood is commonly used for in a wide array of furniture product including table, chair, cabinet and frame due to its good quality of wood.

Figure 8: Zen Hachi - Model making process

CONCLUSION

Zen Hachi gives the idea of simple modern stingless bee storage, which can provide multi-function product as planter pot as well as stingless bee nest. Instead of giving weight at the top for safety, it also can be replaced as planter pot so the farmer can put any suitable plant on top of it. The storage is not easily open by the human or animals to ensure the safety of the bee worker during the foraging process. Zen Hachi also allocates a place for the plant at the top of its body, which will help to provide a food source to the colony to get pollen and honey.

This new design not only provides a modern concept but also eco-friendly where a part of the nest can be transformed into storage for more space for bees to produce honey. For instance, Zen Hachi is one of the solutions for bee keeper because of its portability as well as functionality. With this product, it is expected to help the entrepreneur in stingless bee honey production soon. Zen Hachi also can be used in the housing area in town, a city as well as in a village.

Figure 9: Zen Hachi final design product

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